⌘ AAA! Une sorcière!

Alyssa Rosenzweig

⌘ AAA! She’s a witch!

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⌘ OpenGL

⌘ XDC2023

- OpenGL ES 3.1 (conformant)
- Geometry shaders

⌘ XDC2024

- OpenGL 4.6 (conformant!)
- Tessellation shaders

⌘ Tessellation

⌘ Hardware tessellator

- It… exists?
- Too limited for OpenGL, Vulkan, or Direct3D
- Apple falls back to a software rasterizer

⌘ Hardware lacks…

- Points mode
- Isolines
- Transform feedback
- Geometry shaders

⌘ Software

- Microsoft’s reference tessellator
- 2000 lines of C++

⌘ Reference tessellator

- Tessellates 1 patch
- Reads “tessellation factors”
- Writes tessellated coordinates
- Writes index buffer

⌘ Surprise!

Software Freedom Conservancy 2024-09-12 OpenCL_3_0	433
Conformant Product: Apple M2 running Asahi Linux	Test Version: v2024-08-08-00
Conformant Product: Apple M2 Pro running Asahi Linux	Patches: 21ee05ecafde275886a2fd57499cb4000b446dd7
Conformant Product: Apple M2 Max running Asahi Linux	ARMv8.5-A
Conformant Product: Apple M2 Ultra running Asahi Linux	Compute Device Type: CL_DEVICE_TYPE_GPU
Conformant Product: Apple M1 running Asahi Linux	Compute Device Name: Apple M2 (G14G B0)
Conformant Product: Apple M1 Pro running Asahi Linux	Compute Device Version: OpenCL 3.0
Conformant Product: Apple M1 Max running Asahi Linux	Compute Device Driver Version: 24.3.0-devel (git-790e371866)
Conformant Product: Apple M1 Ultra running Asahi Linux	Compute Device OpenCL C Version: OpenCL 1.2

⌘ So...

2000 lines of C++?

↓

2000 lines of OpenCL C!

⌘ Parallelism

- Each patch in parallel
- Allocate memory with atomic add
- Indirect patch coordinates to avoid a prefix sum

⌘ Index buffer allocation

- Prefix sum?
- Or… generate draws

⌘ Snippet

```
global uint32_t *desc = out_draws + (patch * 6);
uint64_t ib = heap->heap + libagx_heap_alloc(heap, count * 2);

agx_pack(&desc[0], INDEX_LIST, cfg) {
   cfg.index_size      = AGX_INDEX_SIZE_U16;
   cfg.index_buffer_hi = (ib >> 32);
   ...
}

agx_pack(&desc[1], INDEX_LIST_BUFFER_LO, cfg) {
   cfg.index_buffer_lo = ib;
}
```


▼ Vulkan Example
Dynamic terrain tessellation
Apple M2 Max (G14C B1)
3.77 ms/frame (265 fps)
▶ Settings
▼ Pipeline statistics
VS invocations: 16863
TE invocations: 304750

⌘ Performance

CPU	<1 fps
OpenCL	265 fps
Hardware	820 fps

⌘ Vulkan

⌘ Honeykrisp

Software Freedom Conservancy	2024-10-06	Vulkan_1_3	791

Apple M1 (Honeykrisp)

Apple M1 Pro (Honeykrisp)

Apple M1 Max (Honeykrisp)

Apple M1 Ultra (Honeykrisp)

Apple M2 (Honeykrisp)

Apple M2 Pro (Honeykrisp)

Apple M2 Max (Honeykrisp)

Apple M2 Ultra (Honeykrisp)

CTS Version: 1.3.9.2

CPU: Armv8

OS: Linux 6.10.6-401.asahi.fc40.aarch64 16k

⌘ Fun features

- Geometry & tessellation
- Transform feedback
- Shader objects

⌘ Gaming

⌘ The problems

Game	?	System
DirectX	?	Vulkan
Windows	?	Linux
x86	?	arm64
4K	?	16K

⌘ The solutions

Game	🪄	System
DirectX	DXVK	Vulkan
Windows	Wine	Linux
x86	FEX	arm64
4K	?	16K

⌘ Page size

- No heterogenous page sizes
- …but 4K VMs work
- Virtual native context

⌘ The solutions

Game	🪄	System
DirectX	DXVK	Vulkan
Windows	Wine	Linux
x86	FEX	arm64
4K	muvm	16K

⌘ Does it work?


1:00 PM / CLEAR
KAER MORHEN
Use your Witcher Senses to find the key to the bedroom door.
Witcher Senses [Hold]


HP
N


FEDERAL BUREAU OF CONTROL


PARTS
廉價酒
0708
WHISPER
Your implants are still adjusting to the software.


Exit

⌘ Release

⌘ ETA

⌘ ETA

Now

⌘ Now released!

- Vulkan 1.3
- OpenCL 3.0
- x86 gaming (alpha)

https://alx.sh/gaming

```
# dnf install steam
```

⌘ Thank you

Alyssa Rosenzweig